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90-090B-08A

ULYSSES

HOURLY AVERAGED INTERPLANETARY CURISE FIELD DATA

90-090B-08B

ULYSSES

1-MINUTE AVERAGE INTERBLN MAG FLD

90-090B-08C

ULYSSES

1-MINUTE AVERAGE JOVIAN MAG FIELD

ULYSSES
HOURLY AVERAGED INTERPLANETARY CRUISE MAGNETIC FIELD DATA
90-090B-08A

THIS DATA SET CONSISTS OF 1 MAGNETIC TAPE. THE TAPE IS 9-TRACK, 6250 BPI, WRITTEN IN ASCII AND CREATED ON A VAX COMPUTER, WITH A LABEL NAME OF "ULYMAG". INCLUDED IN THE CATALOG IS A COPY OF THE FORMAT FOR THE MAGNETIC FIELD DATA.

THE D AND C NUMBER ALONG WITH ITS TIME SPAN IS LISTED BELOW.

D#	C#	FILES	TIMESPAN
D-108213	C-031960	<u>7</u>	10/25/90-06/30/95

THIS DATA WAS DOWNLOADED FROM THE ANON_DIR: [COHO.ULYMAG.HOUR]

Directory \$1\$MUA1:[]

ULYMAG90.DAT;1
ULYMAG94.DAT;2

ULYMAG91.DAT;1
ULYMAG95.DAT;3

ULYMAG92.DAT;2
ULYMAGHR.FMT;12

ULYMAG93.DAT;2

Total of 7 files.

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ULYSSES HOURLY AVERAGED INTERPLANETARY CRUISE MAGNETIC FIELD DATA

Data Set Coverage (yyy-mm-dd): 1990-10-25 to 1992-02-02
1992-02-16 to 1995-06-30
{excluding Jupiter encounter, Feb. 3 - 15, 1992}

Satellite: Ulysses

Experiment: Ulysses Magnetic Field

Principal Investigator: Dr. A. Balogh, Imperial College, London, UK

Data Set Contact: C. Tranquille, Ulysses Data System, SSD-ESA, ESTEC

Data Set Submission Date: 1996-05-01 (most recent update)

Data Set Description:

This data set contains hourly averages of the interplanetary magnetic field measured by the Ulysses Magnetic Field experiment. Field vector components are given in units of nanoteslas and in RTN coordinates, where R is the sun-s/c axis, T is the cross product of the solar rotation axis and R, and N is the cross product of R and T. The field magnitudes in nT are averages of scalar magnitudes at higher time resolution. Times are computed at the mid-point of each hour interval and expressed in Spacecraft Event Time - UT (SCET-UT). For statistical checks the number of full resolution vectors contributing to the average in each interval is provided. Data gaps have not been flagged in any way - if there were no available data in a particular hour then there is no data record for that hour. No data from the Feb. 1992 encounter with Jupiter are included. Further details on the magnetic field measurements can be found in the following reference: Balogh, A., et al., Astron. Astrophys. Suppl. Ser., 92(2), 221, 1992. This data set is available on-line in the NSSDC Anonymous FTP directory and in the COHWeb browse/display system on World Wide Web. See NSSDC's Ulysses flight project page under URL http://nssdc.gsfc.nasa.gov/space/space_physics_home.htm for further details.

Data Set Files:

ULYMAGHR.FMT - this file

ULYMAGyy.DAT - yearly hour average data file for year "yy" (ASCII)

Parameter Format for ULYMAGyy.DAT:

This file has ASCII table format with eight columns:

- 1) Year (two digit integer)
- 2) Decimal day no. (January 1 = Day 1, fractional part completely specifies the timing of the data point)
- 3) Decimal hour (actually redundant but aids readability of the file)
- 4) Magnetic field hour average of R component (nT)
- 5) Magnetic field hour average of T component (nT)
- 6) Magnetic field hour average of N component (nT)
- 7) Magnetic field hour average magnitude (nT) (note that this is the average of the magnitudes of the individual full resolution vectors)

- as opposed to the magnitude of the vector formed by the hourly averaged components)
- 8) Number of full resolution vectors that have contributed to the average (as a crude statistical validity check)

NSSDC Data Set ID: 90-090B-08A

NSSDC Data Set Location:

Off-line: request via e-mail to request@nssdca.gsfc.nasa.gov

On-line: COHO directory at nssdca::anon_dir:coho.ulymag.hour

Near-line: Ulysses project data set on NDADS (ingest pending)

Acknowledgement:

Please acknowledge the National Space Science Data Center and the Principal Investigator, A. Balogh of Imperial College, London, UK.

Related Information:

Other information about the Ulysses mission, experiments, and data sets at NSSDC may be obtained via World Wide Web and NSSDC's space physics page at http://nssdc.gsfc.nasa.gov/space/space_physics_home.html. Non-WWW users may access NSSDC information in the NASA Master Directory and the NSSDC Master catalog via Internet login to the NSSDC On-Line Data Information Service (NODIS) at nodis@nssdca.gsfc.nasa.gov.

Ulysses data on NDADS (NASA's Data Archive and Distribution Service) may be located via WWW as above or via an e-mail message to ARMS (Automated Retrieval Mail System) at archives@ndadsa.gsfc.nasa.gov with "HOLDINGS" on the subject line.

Ulysses
90-0908-088

1

ULYSSES

90-090B-08B

1-MINUTE AVG INTERPL MAGNETIC FIELDS

THIS DATA SET CONSISTS OF 2 MAGNETIC TAPE. THE TAPE IS 9-TRACK, 6250 BPI, WRITTEN IN ASCII AND CREATED ON A VAX COMPUTER, WITH A LABEL NAMES OF "MGFLD1" FOR THE FIRST TAPE AND "MGFLD2" FOR THE SECOND TAPE. A COPY OF THE FORMAT AND A DIRECTORY OF THE TAPES HAVE BEEN INCLUDED IN THE CATALOG. THE D AND C NUMBERS ALONG WITH IT'S TIMESPAN ARE LISTED BELOW.

D#	C#	FILES	TIMESPAN
D-108214	C-031961	118	10/25/90-12/06/93
D-108721	C-032816	59	01/01/94-06/29/95

** THIS DATA WAS DOWNLOADED FROM THE ANON_DIR: [COHO.ULYMAG.MINUTE] **

D-108214
Label=MGFLD1

U90298MINSH.DAT;1	U90300MINSH.DAT;1	U90310MINSH.DAT;1	U90320MINSH.DAT;1
U90330MINSH.DAT;2	U90340MINSH.DAT;1	U90350MINSH.DAT;1	U90360MINSH.DAT;1
U91001MINSH.DAT;1	U91010MINSH.DAT;1	U91020MINSH.DAT;1	U91030MINSH.DAT;1
U91040MINSH.DAT;2	U91050MINSH.DAT;1	U91060MINSH.DAT;1	U91070MINSH.DAT;2
U91080MINSH.DAT;2	U91090MINSH.DAT;1	U91100MINSH.DAT;2	U91110MINSH.DAT;2
U91120MINSH.DAT;1	U91130MINSH.DAT;1	U91140MINSH.DAT;2	U91150MINSH.DAT;1
U91160MINSH.DAT;2	U91170MINSH.DAT;1	U91180MINSH.DAT;1	U91190MINSH.DAT;2
U91200MINSH.DAT;2	U91210MINSH.DAT;2	U91220MINSH.DAT;2	U91230MINSH.DAT;2
U91240MINSH.DAT;1	U91250MINSH.DAT;1	U91260MINSH.DAT;2	U91270MINSH.DAT;2
U91280MINSH.DAT;2	U91290MINSH.DAT;1	U91300MINSH.DAT;1	U91310MINSH.DAT;1
U91320MINSH.DAT;2	U91330MINSH.DAT;2	U91340MINSH.DAT;1	U91350MINSH.DAT;1
U91360MINSH.DAT;1	U92001MINSH.DAT;1	U92010MINSH.DAT;1	U92020MINSH.DAT;1
U92030MINSH.DAT;1	U92050MINSH.DAT;1	U92060MINSH.DAT;1	U92070MINSH.DAT;1
U92080MINSH.DAT;1	U92090MINSH.DAT;1	U92100MINSH.DAT;1	U92110MINSH.DAT;1
U92120MINSH.DAT;1	U92130MINSH.DAT;1	U92140MINSH.DAT;1	U92150MINSH.DAT;1
U92160MINSH.DAT;1	U92170MINSH.DAT;1	U92180MINSH.DAT;1	U92190MINSH.DAT;1
U92200MINSH.DAT;1	U92210MINSH.DAT;1	U92220MINSH.DAT;1	U92230MINSH.DAT;1
U92240MINSH.DAT;1	U92250MINSH.DAT;1	U92260MINSH.DAT;1	U92270MINSH.DAT;1
U92280MINSH.DAT;1	U92290MINSH.DAT;1	U92300MINSH.DAT;1	U92310MINSH.DAT;1
U92320MINSH.DAT;1	U92330MINSH.DAT;1	U92340MINSH.DAT;1	U92350MINSH.DAT;1
U92360MINSH.DAT;1	U93001MINSH.DAT;1	U93010MINSH.DAT;1	U93020MINSH.DAT;1
U93030MINSH.DAT;1	U93040MINSH.DAT;1	U93050MINSH.DAT;1	U93060MINSH.DAT;1
U93070MINSH.DAT;1	U93080MINSH.DAT;1	U93090MINSH.DAT;1	U93100MINSH.DAT;1
U93110MINSH.DAT;1	U93120MINSH.DAT;1	U93130MINSH.DAT;1	U93140MINSH.DAT;1
U93150MINSH.DAT;1	U93160MINSH.DAT;1	U93170MINSH.DAT;1	U93180MINSH.DAT;1
U93190MINSH.DAT;1	U93200MINSH.DAT;1	U93210MINSH.DAT;1	U93220MINSH.DAT;1
U93230MINSH.DAT;1	U93240MINSH.DAT;1	U93250MINSH.DAT;1	U93260MINSH.DAT;1
U93270MINSH.DAT;2	U93280MINSH.DAT;1	U93290MINSH.DAT;1	U93300MINSH.DAT;1
U93310MINSH.DAT;1	U93320MINSH.DAT;1	U93330MINSH.DAT;1	U93340MINSH.DAT;1
U93350MINSH.DAT;1	U93360MINSH.DAT;1		

Total of 118 files.

D-108721
Label=MGFLD2

U94001MINSH.DAT;1	U94010MINSH.DAT;1	U94020MINSH.DAT;1	U94030MINSH.DAT;1
U94040MINSH.DAT;1	U94050MINSH.DAT;1	U94060MINSH.DAT;1	U94070MINSH.DAT;1
U94080MINSH.DAT;1	U94090MINSH.DAT;1	U94100MINSH.DAT;1	U94110MINSH.DAT;1
U94120MINSH.DAT;1	U94130MINSH.DAT;1	U94140MINSH.DAT;1	U94150MINSH.DAT;1
U94160MINSH.DAT;1	U94170MINSH.DAT;1	U94180MINSH.DAT;1	U94182MINSH.DAT;1
U94190MINSH.DAT;1	U94200MINSH.DAT;1	U94210MINSH.DAT;1	U94220MINSH.DAT;1
U94230MINSH.DAT;1	U94240MINSH.DAT;1	U94250MINSH.DAT;1	U94260MINSH.DAT;1
U94270MINSH.DAT;1	U94280MINSH.DAT;1	U94290MINSH.DAT;1	U94300MINSH.DAT;1
U94310MINSH.DAT;1	U94320MINSH.DAT;1	U94330MINSH.DAT;1	U94340MINSH.DAT;1
U94350MINSH.DAT;1	U94360MINSH.DAT;1	U95001MINSH.DAT;1	U95010MINSH.DAT;1
U95020MINSH.DAT;1	U95030MINSH.DAT;1	U95040MINSH.DAT;1	U95050MINSH.DAT;1
U95060MINSH.DAT;1	U95070MINSH.DAT;1	U95080MINSH.DAT;1	U95090MINSH.DAT;1
U95100MINSH.DAT;1	U95110MINSH.DAT;1	U95120MINSH.DAT;1	U95130MINSH.DAT;1
U95140MINSH.DAT;1	U95150MINSH.DAT;1	U95160MINSH.DAT;1	U95170MINSH.DAT;1
U95180MINSH.DAT;1	ULYMAGMN.FMT;17	WOLF_4.TXT;1	

Total of 59 files.

Format for Ulysses 1-minute avg magnetic field files

Each line contains Year, Day (1 = Jan 1), Hour, Minute, Second, BR, BT, BN, B in the format (1x,i2,i4.3,3i3.2, 4f8.3).

The time tag is the midpoint of the one-minute averaging interval. BR, BT, and BN are the minute averages of the field components in the SH (or RTN) system. B is the minute average of the field magnitude, not the magnitude of the average field vector. Field units are nT.

No records are written for data gaps.

Most files cover 10-day intervals, except that the first file of each year covers days 1-9, and the last file of each year covers days 360-365 (or 366).

The current submission of 38 files includes the data from 1994, day 182 to 1995, day 182 inclusive.

-Joyce Wolf, JPL, 6 Nov 1996.

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ULYSSES 1-MINUTE AVERAGED INTERPLANETARY CRUISE MAGNETIC FIELD DATA

Data Set Coverage (yyy-mm-dd): 1990-10-25 to 1992-02-02 (pre-Jupiter)
1992-02-19 to 1995-06-30 (post-Jupiter)

Satellite: Ulysses

Experiment: Ulysses Magnetic Field

Principal Investigator: Dr. A. Balogh, Imperial College, London, UK

Data Set Contact: Joyce Wolf, NASA Jet Propulsion Laboratory

Data Set Submission Date: 1995-06-22 (pre-Jupiter data)
1995-11-03 (post-Jupiter data)
1996-06-05 (new cruise data)
1996-11-06 (new cruise data)

Data Set Description:

This data set contains one minute averages of the interplanetary magnetic field measured by the Ulysses Magnetic Field experiment. Field vector components are given in units of nanoteslas and in RTN coordinates, where R is the sun-s/c axis, T is the cross product of the solar rotation axis and R, and N is the cross product of R and T. The field magnitudes in nT are averages of scalar magnitudes at higher time resolution. Times are computed at the mid-point of each minute interval and expressed in Spacecraft Event Time - UT (SCET-UT). Data gaps have not been flagged in any way - if there were no available data in a particular hour then there is no data record for that hour. No data from the Feb. 1992 encounter with Jupiter are included. Most files cover 10-day intervals, except that the first file of each year covers days 1-9, and the last file of each year covers days 360-365 (or 366). Further details on the magnetic field measurements can be found in the following reference: Balogh, A., et al., Astron. Astrophys. Suppl. Ser., 92(2), 221, 1992. This data set is available on-line in the NSSDC Anonymous FTP directory and will also be put on the NDADS near-line system. See NSSDC's Ulysses flight project page under URL http://nssdc.gsfc.nasa.gov/space/space_physics_home.htm for further details.

Data Set Files:

ULYMAGMN.FMT - this file
UyydddMINSH.DAT - minute average data files (ASCII) starting at day yyddd

Parameter Format for File UyydddMINSH.DAT:

IY	SCET-UT year (yy)
IDOY	SCET-UT day of year (ddd), IDOY = 1 for Jan. 1
IHR	SCET-UT hour of day
IMIN	SCET-UT minute of hour
ISEC	SCET-UT second of minute
BR	Radial component (RTN system) of vector magnetic field in nT
BT	Transverse component (RTN system) of vector magnetic field in nT
BN	Normal component (RTN system) of vector magnetic field in nT
B	Scalar magnitude of magnetic field in nT

The data records are read in ASCII FORTRAN format as follows:

```
110      READ(10,110) IY, IDOY, IHR, IMIN, ISEC, BR, BT, BN, B
      FORMAT (1X,I2,I4.3,3I3.2, 4F8.3)
```

NSSDC Data Set ID: 90-090B-08B

NSSDC Data Set Location:

Off-line: request via e-mail to request@nssdca.gsfc.nasa.gov

On-line: COHO directory at [nssdca::anon_dir:\[coho.ulymag.minute\]](#)

Near-line: Ulysses project data set on NDADS (ingest pending)

Acknowledgement:

Please acknowledge the National Space Science Data Center and the Principal Investigator, A. Balogh of Imperial College, London, UK.

Related Information:

Other information about the Ulysses mission, experiments, and data sets at NSSDC may be obtained via World Wide Web and NSSDC's space physics page at http://nssdc.gsfc.nasa.gov/space/space_physics_home.html. Non-WWW users may access NSSDC information in the NASA Master Directory and the NSSDC Master catalog via Internet login to the NSSDC On-Line Data Information Service (NODIS) at nodis@nssdca.gsfc.nasa.gov.

Ulysses data on NDADS (NASA's Data Archive and Distribution Service) may be located via WWW as above or via an e-mail message to ARMS (Automated Retrieval Mail System) at archives@ndadsa.gsfc.nasa.gov with "HOLDINGS" on the subject line.

Updates:

5/28/96: file U90330MINSH.DAT has been replaced since the earlier version submitted to NSSDC covered the wrong dates. The corrected version date of this file is now 3/7/96.

6/10/96: file U93270MINSH.DAT did not originally extend for the full 10-day period but now does in the new data just submitted.

90-0908-08C
1-Min Avg Jovian Mag field

ULYSSES

MAGNETOMETER 1-MINUTE AVG JOVIAN MAG FIELD

90-090B-08C

THIS DATA SET CONSISTS OF 1 MAGNETIC TAPE. THE TAPE IS 9-TRACK, 6250 BPI, WRITTEN IN ASCII AND CREATED ON A VAX COMPUTER, WITH A LABEL NAME OF "JOVIAN". INCLUDED IN THE CATALOG IS A DIRECTORY LISTING OF THE TAPE AND A COPY OF THE FORMAT.

THE D AND C NUMBER ALONG WITH IT'S TIME SPAN IS LISTED BELOW.

D#	C#	FILES	TIMESPAN
D-108773	C-032870	<u>49</u>	10/25/92 - 02/17/92

*** DATA WAS DOWNLOADED FROM THE ANON_DIR: [COHO.ULYMAG.JUPITER] ***

Directory D-108773

FGM92038.DAT;1	FGM92039.DAT;1	FGM92040.DAT;1	JUPITER.FMT;12
TRJ92025.DAT;1	TRJ92026.DAT;1	TRJ92027.DAT;1	TRJ92028.DAT;1
TRJ92029.DAT;1	TRJ92030.DAT;1	TRJ92031.DAT;1	TRJ92032.DAT;1
TRJ92033.DAT;1	TRJ92034.DAT;1	TRJ92035.DAT;1	TRJ92036.DAT;1
TRJ92037.DAT;1	TRJ92038.DAT;1	TRJ92039.DAT;1	TRJ92040.DAT;1
TRJ92041.DAT;1	TRJ92042.DAT;1	TRJ92043.DAT;1	TRJ92044.DAT;1
TRJ92045.DAT;1	TRJ92046.DAT;1	TRJ92047.DAT;1	TRJ92048.DAT;1
VHM92025.DAT;1	VHM92026.DAT;1	VHM92027.DAT;1	VHM92028.DAT;1
VHM92029.DAT;1	VHM92030.DAT;1	VHM92031.DAT;1	VHM92032.DAT;1
VHM92033.DAT;1	VHM92034.DAT;1	VHM92035.DAT;1	VHM92036.DAT;1
VHM92037.DAT;1	VHM92041.DAT;1	VHM92042.DAT;1	VHM92043.DAT;1
VHM92044.DAT;1	VHM92045.DAT;1	VHM92046.DAT;1	VHM92047.DAT;1
VHM92048.DAT;1			

Total of 49 files.

The following description applies to the Ulysses Magnetometer data files for the 1992 Jupiter Encounter, submitted in June 1996 by Joyce Wolf for the Ulysses Magnetometer Team at JPL and Imperial College (A. Balogh, Principal Investigator).

Files and Data Coverage

The data set covers the period Jan 25 through Feb 18, 1992 (days 25 to 48 inclusive).

Files VHM92xxx.DAT and FGM92xxx.DAT contain one minute averages of the magnetic field components and magnitude measured by either the VHM (Vector Helium Magnetometer) or FGM (Fluxgate Magnetometer), where xxx = Day of Year (025 = Jan 25). The three days of closest approach (38-40) are FGM; the others are VHM.

Files TRJ92xxx.DAT contain positions and attitude of Ulysses. Time resolution is the same as the final SEDR: 1 minute for Days 32-47, 3 hours for Days 25-31, 1 hour for Day 48.

File Formats

Each line in the VHM/FGM files contains Year (2 digits), Day of Year, Hour, Minute, Second, BR, BTHETA, BPHI, BMAGNITUDE in the format (1x,i2,i4.3, 3i3.2, 4f10.2). The time tag is the midpoint of the one minute averaging interval. BMAGNITUDE is the average of the field magnitude, not the magnitude of the average field vector. Field units are nT. BR, BTHETA and BPHI are one-minute averages of the field components in R-THETA-PHI coordinates (see below).

Each line of the TRJ files contains Year, Day of year, Hour, Minute, Second, R, RLATJG, RLONJG, RLATEC, RLONEC, AXISLAT, AXISLON, XSU, YSU, ZSU in the format (1x,i2,i4.3,3i3.2, f12.5, 2f8.3, 2x, 2f8.3, 2x, 2f8.3, 3f12.1). R is the distance from Jupiter to Ulysses measured in RJ (1 RJ = 71398 km). The next 6 parameters are angles measured in deg. RLATJG and RLONJG are the latitude and west longitude of Ulysses in the Jovigraphic System III (1965.0). RLATEC and RLONEC are the latitude and longitude of the Jupiter-to-Ulysses unit vector in ECL50 (Earth Mean Ecliptic and Equinox of 1950.0). AXISLAT and AXISLON are the latitude and longitude of the Ulysses spin axis in ECL50. XSU, YSU, and ZSU are the Cartesian components of the Sun-to-Ulysses vector in ECL50.

Coordinate System

The field components are given in the R-THETA-PHI system, which is that conventionally used for comparison with models. The R axis is from Jupiter to Ulysses; the THETA axis is perpendicular to R and lies in the plane containing R and Jupiter's rotation axis and is positive southward; PHI completes the orthogonal right-handed system.

The TRJ files contain all the parameters necessary to transform the field components into System III, ECL50, or inertial spacecraft coordinates. See Computation of Coordinate Transformations, below.

Data Processing

VHM files were produced by first averaging high resolution (1s or 2s) field data in inertial spacecraft coordinates. Then the averages were transformed into R-THETA-PHI coordinates, using parameters from the Final SEDR (Supplementary Experiment Data Records). FGM files were produced in a similar manner by R.J. Forsyth at Imperial College; these files were then reformatted at JPL to make the time tags consistent with those in the VHM files.

TRJ files are simply convenient extractions of parameters from the Final SEDR.

Accuracy

Since the VHM sensor has greater resolution (4 pT in the ± 8 nT range), it was decided that the best quality dataset would consist of VHM data for the majority of the encounter period and FGM for days 38-40 when the VHM was in saturation.

We feel that both VHM and FGM datasets have been individually calibrated to the best level that we can achieve at this time. It is possible that further small improvements could be made in the cross calibration between the two sensors; in the present dataset the differences between VHM and FGM at the beginning of day 38 and at the end of day 40 are less than 0.5 nT.

For the position of Ulysses in Jupiter-centered coordinates, 1-sigma uncertainties are less than 1 part in 1 million, or less than 0.5 km at closest approach.

The attitude of Ulysses during the Jupiter encounter interval is stated to be accurate within ± 0.005 degrees.

Computation of Coordinate Transformations

The paragraphs below give methods for computing transformation matrices using trajectory parameters from the TRJ files. As an alternative, note that the appendix in [Smith 1993] contains the orbital elements of Ulysses with respect to Jupiter and demonstrates how to calculate the position of Ulysses in System III and other coordinate systems without recourse to trajectory data files.

The transformation matrix from R-THETA-PHI to System III (1965.0) consists of the column vectors of the R, THETA, and PHI axes expressed in System III. The R-axis in System III is $\cos(\text{RLATJG}) \cos(360-\text{RLONJG})$, $\cos(\text{RLATJG}) \sin(360-\text{RLONJG})$, $\sin(\text{RLATJG})$. The PHI axis is the normalized crossproduct $\mathbf{J} \times \mathbf{R}$, where \mathbf{J} is the rotation axis which is just 0,0,1, so the unit vector in the PHI direction is $-\sin(360-\text{RLONJG})$, $\cos(360-\text{RLONJG})$, 0. The unit vector in the THETA direction is the crossproduct $\mathbf{PHI} \times \mathbf{R} = \sin(\text{RLATJG}) \cos(360-\text{RLONJG})$, $\sin(\text{RLATJG}) \sin(360-\text{RLONJG})$, $-\cos(\text{RLATJG})$.

The transformation matrix from R-THETA-PHI back to ECL50 consists of the column vectors of the R, THETA, and PHI axes expressed in ECL50. R is $\cos(\text{RLATEC}) \cos(\text{RLONEC})$, $\cos(\text{RLATEC}) \sin(\text{RLONEC})$, $\sin(\text{RLATEC})$. PHI is the normalized crossproduct $\mathbf{J} \times \mathbf{R}$, where \mathbf{J} (North Pole of Jupiter)

is given in the reference [Smith 1993] as -92.002 RA, 64.504 DEC, Earth Mean Equinox and Equator 1950.0. Rotating by 23.4458 deg (1950.0 obliquity) gives J in ECL50 = (-.015037545, -.035534090, 0.999255323). The THETA axis is PHI x R.

Inertial spacecraft coordinates are defined as follows: Z is the Ulysses spin axis, which points approximately towards Earth; X is perpendicular to Z and lies in the plane containing Z and S, where S is the Ulysses-to-Sun vector. X is positive toward the Sun. Z in ECL50 is $\cos(\text{AXISLAT}) \cos(\text{AXISLON})$, $\cos(\text{AXISLAT}) \sin(\text{AXISLON})$, $\sin(\text{AXISLAT})$. S in ECL50 is -XSU, -YSU, -ZSU. The Y axis is the normalized crossproduct $Z \times S$, and the X axis is $Y \times Z$. The transformation matrix from ECL50 back to inertial spacecraft coordinates consists of the column vectors X, Y, and Z.

The TRJ files in this submission include all the parameters necessary to calculate the above transformations. In a few cases where the direction of the spin axis was not available in the SEDR, the Ulysses-to-Earth direction was substituted in the TRJ files. It is suggested that interpolations in time be performed on vector components rather than angles in order to avoid difficulties near 0 or 360, and that double precision arithmetic be used in matrix multiplication.

References

- Smith, E.J., and Wenzel, K.-P. Introduction to the Ulysses Encounter with Jupiter, J. Geophys. Res., 98, 21111, 1993.
- Balogh, A., et al. The magnetic field investigation on the Ulysses mission: Instrumentation and preliminary scientific results, Astron. Astrophys. Suppl. Ser., 92, 221, 1992a.
- Balogh, A., et al. Magnetic field observations during the Ulysses flyby of Jupiter, Science, 257, 1515-1518, 1992.

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